Pure

Scotland's Rural College

Evaluation of farmer participatory extension programmes

Knook, J; Eory, V; Brander, M; Moran, D

Published in:
The Journal of Agricultural Education and Extension

DOI:
10.1080/1389224X.2018.1466717

First published: 26/04/2018

Document Version
Peer reviewed version

Link to publication

Citation for pulished version (APA):
Knook, J., Eory, V., Brander, M., & Moran, D. (2018). Evaluation of farmer participatory extension programmes. *The Journal of Agricultural Education and Extension*, *24*(4), 309 - 325. https://doi.org/10.1080/1389224X.2018.1466717

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 05. May. 2023

JOURNAL OF AGRICULTURAL EDUCATION AND EXTENSION, 2018
https://doi.org/10.1080/1389224X.2018.1466717

Routledge
Taylor & Francis Group

Check for updates

Evaluation of farmer participatory extension programmes

Jorie Knook[a,b], Vera Eory[b], Matthew Brander[a] and Dominic Moran[c]

[a]University of Edinburgh Business School, Edinburgh, UK; [b]Land Economy, Environment and Society, Scotland's Rural College, Edinburgh, UK; [c]The Royal (Dick) School of Veterinary Studies, The Roslin Institute, University of Edinburgh, Edinburgh, UK

ABSTRACT

Purpose: Participatory extension programmes are widely used to promote change in the agricultural sector, and an important question is how best to measure the effectiveness of such programmes after implementation. This study seeks to understand the current state of practice through a review of *ex post* evaluations of participatory extension programmes.

Design/methodology/approach: A systematic literature review of the peer-reviewed literature was undertaken to analyse the evaluations based on: (i) year of publication; (ii) location of the study; (iii) programme delivery; (iv) evaluation methods; (v) outcome variables; and (vi) inclusion of evaluation in initial programme design.

Findings: The review finds that almost all studies use an experimental or quasi-experimental research design (i.e. using a control group or counterfactual), but some studies do not account for endogeneity or selection bias. Furthermore, only a small number of the evaluations were planned as part of the original programme design, which causes difficulties in obtaining robust counterfactuals. The review also finds that relatively few evaluations, approximately 20%, measure the programme impact on environmental outcomes and only 15% of the evaluations have been undertaken for programmes in developed countries.

Practical implication: Limitations with current evaluation practice are identified, and recommendations are provided for improving practice, including better treatment of endogeneity, and the complementary use of qualitative data.

Theoretical implication: The review provides a contribution to the debate about the use of quantitative versus qualitative evaluation methods, by addressing the use of both quantitative and qualitative evaluation methods in a complementary way.

Originality/value: Despite their widespread implementation, this is the first systematic literature review for published evaluations of participatory extension programmes in the agricultural sector.

ARTICLE HISTORY
Received 11 September 2017
Accepted 16 April 2018

KEYWORDS
Impact evaluation; voluntary uptake; extension programme; agriculture; ex post evaluation; discussion groups

Introduction

AQ2 Extension activities are widely applied to stimulate change in the agricultural sector (Black 2000). For many years, the extension was based on the linear top-down transfer of technology, in which technology was developed and validated by researchers, communicated

CONTACT Jorie Knook jorie.knook@sruc.ac.uk University of Edinburgh Business School, 29 Buccleuch Place, Edinburgh EH8 9JS, UK; Land Economy, Environment and Society, Scotland's Rural College, West Mains Road, Edinburgh EH9 3JG, UK

© 2018 Wageningen University

by extension agents and adopted by farmers (Black 2000). However, since the 1980s, this approach has been subjected to various critiques, such as failing to account for the context and complexity of the agricultural sector (Pretty and Chambers 2003), which in turn decreases the adoption of technology. Therefore, an alternative extension approach has been developed in which farmers play a more central or 'participatory' role in the acquisition of knowledge and change of practice (Scoones and Thompson 2009; Cristóvão, Koutsouris, and Kügler 2012) In these 'participatory' extension programmes (PEPs), researchers and extension agents fulfil a facilitating role, while farmers actively set the agenda and engage with their peers (Black 2000).

Given the public investment in PEPs, and the increasing requirement for accountability by policy-makers and funding bodies, it is important that these programmes are reliably evaluated (Faure, Desjeux, and Gasselin 2012; Klerkx, Landini, and Santoyo-Cortés 2016). However, evaluating PEPs might present new challenges, as PEPs may require a different evaluation approach than the evaluation of top-down extension programmes. The evaluation of top-down programmes is mostly focused on programme outcomes, but it is questioned whether this approach sufficiently addresses the main aim of PEPs, which is to include farmers in agenda setting and collective learning (Murray 2000). Therefore, it is interesting to identify the current state of evaluation practice and identify recommendations for improvement.

To identify the current state of practice, this study provides a systematic review of peer-reviewed evaluations for PEPs. Although previous reviews overlap this topic, e.g. reviews focused on Farmer Field Schools (FFS) (Van den Berg 2004; Davis 2006; Van Den Berg and Jiggins 2007), or evaluations of all types of extension programmes (World Bank, 2011), this review is the first – to the authors' knowledge – to focus specifically on PEP evaluations. The contribution lies in the identification of best practice for *ex post* evaluation methods, derived from the peer-reviewed literature for agricultural PEPs. Ultimately, the review identifies limitations within the currently applied evaluation methods and provides recommendations for future evaluations. The remainder of this paper proceeds as follows: Section two describes the systematic review method; Section three presents and discusses the findings from the review, and the paper concludes with a number of recommendations.

PROOF ONLY

Methods

Definition and scope

PEPs are programmes in which farmers interact with peers and experts, where experts fulfil a facilitating role and farmers actively participate in goal and agenda setting. Programme meetings take place over a period of time and create knowledge by participatory learning methods, such as group or one-on-one meetings, training sessions and (experimental) demonstrations (Black 2000). The intended outcomes from PEPs include changing farm practices, enhancing social learning, increasing resilience to challenges and uncertainties, and sharpening farmers' management skills and decision-making abilities (Cristóvão, Koutsouris, and Kügler 2012).

This systematic review focuses on peer-reviewed studies that measure the effect of PEPs *ex post*, that is, after the implementation. Although there are evaluation studies reported in the grey literature, i.e. the sources of literature outside of traditional academic publications,

such as theses, reports from governments or organisations and working papers, these are not included in the review, because the main aim is to identify best practice for evaluation from a scientific perspective.

Sources of information

An initial inventory of peer-reviewed publications on the evaluation of PEPs was conducted including studies until August 2017, by using the electronic databases of ISI Web of Knowledge (www.isiknowledge.com) and Google Scholar (scholar.google.com). We used the following key words, either alone or in combination: 'agriculture', 'evaluation', 'participatory extension programme', 'voluntary advisory programme', 'policy', intervention', 'impact' and 'assessment'. This initial search resulted in 45 publications. To provide a more exhaustive list of evaluations, we conducted a second search in the previously mentioned electronic databases including studies until December 2017, by using additional search terms often associated with PEPs (Black 2000; Braun 2006; Cristóvão, Koutsouris, and Kügler 2012): 'participatory learning and action', 'participatory technology development', 'facilitation of local processes', 'local development', 'agroecological extension', 'farmer field schools', 'farmer first', 'farmer-led extension', 'farmer networks', 'study circles', 'farming systems research and extension', 'farmer study groups', 'rural resource center', 'farmer to farmer training', 'master farmer training', 'local learning groups', 'participatory advisory programme and discussion groups'. This yielded an additional 26 studies, bringing the total to 71. This expanded set of key words may still not provide an exhaustive list, but address the main studies in this field.

To focus on recently conducted studies which evaluate the effect of PEPs, we only included publications which: (i) focus on the effect after implementation of the PEPs, also referred to as 'ex post' evaluations; (ii) present the effect of the PEP using empirical findings; (iii) focus on PEPs within the agricultural sector; and (iv) have been published in or after the year 2000. The search resulted in 71 studies, which we further analysed based on six aspects. Firstly, the year of publication was used to identify a trend in the number of evaluations over time. Secondly, the location of the programme was identified to analyse the spatial distribution of the PEPs evaluated. Thirdly, the type of delivery was analysed, to find similarities in programme design. There are, for instance, a number of studies that apply the farmer field school approach, which is a uniform programme design applied in many developing countries. Fourthly, evaluation methods were categorised to identify the types of method and their frequency of use. Fifthly, the outcome variables used in the evaluation studies were identified, e.g. economic outcome variables, environmental outcome variables, etc. Finally, we identified whether the evaluation studies were built into the initial programme design. In the absence of any explicit mention of an evaluation in initial programme design, the presence of a baseline survey was taken as an indicator of evaluation planning.

Findings and discussion

General findings

A total of 71 published evaluation studies for PEPs were identified, from 42 different journals. A general finding in relation to terminology is that 'impact assessment', 'effect' or

PROOF ONLY

'effectiveness' are used interchangeably to indicate some form of quantitative evaluation. Sixty-eight out of 71 studies found a positive difference after the intervention, the exceptions being Feder, Murgai, and Quizon (2004a, 2004b) and Rejesus et al. (2012). It is possible that there are additional, unpublished, evaluations that do not show a positive effect on the participants, but these have not been published in the scientific literature due to publication bias, i.e. editors, funders, reviewers and researchers have a preference for studies that show a statistically significant effect (Duflo et al. 2007).

The Appendix provides an overview of the collected studies that will be discussed in terms of the six aspects previously mentioned.

Year, location and type of delivery

Only eight publications were found that conducted an evaluation between 2000 and 2006, indicating an increase in evaluations over the last decade (Figure 1).

An overview of the studies categorised per continent is depicted in Figure 2. Analysis of the location of the studies shows that the majority of the studies have been conducted in countries in Africa and Asia. Further analysis shows that 62 of the 71 studies were conducted in developing countries (as classified by the United Nations (2018)), which can be explained by the fact that the majority of PEPs are implemented in the developing world (Anderson and Feder 2004). A popular type of PEP in developing countries are FFS, which use education to strengthen farmers' capacity to what can be considered as 'best practices'. Typically, FFSs consist of 20–25 farmers who, under the guidance of a trained facilitator, meet on a weekly basis for a predefined period to discuss environmental topics, such as soil fertility and pest management, but also other topics, such as the development of marketing skills (FAO 2017). Forty-eight out of the 62 developing country studies focused on the evaluation of these FFSs. The other 14 evaluations were applied to a wide range of PEPs. For instance, Pamuk, Bulte, and Adekunle (2014) and Pamuk

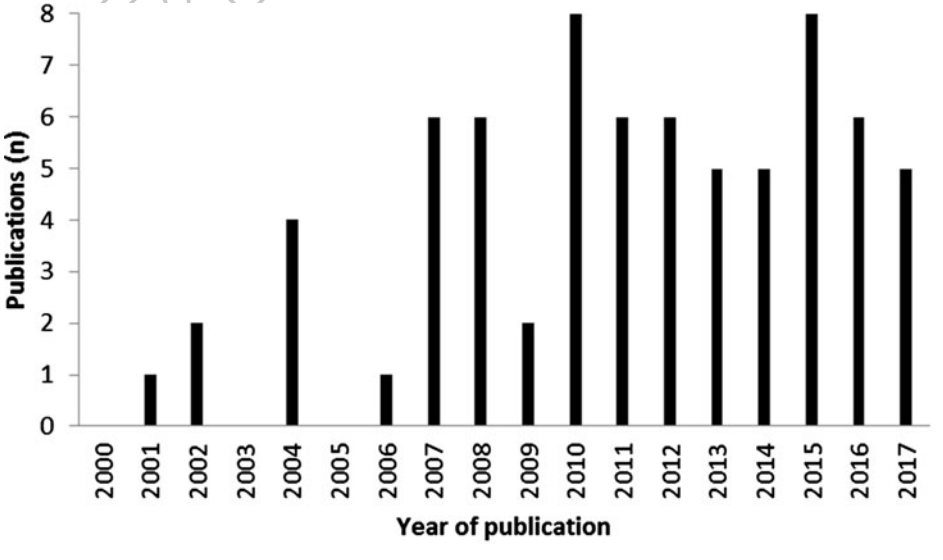


Figure 1. Evaluations of the participatory extension programmes by the year of publication.

PROOF ONLY

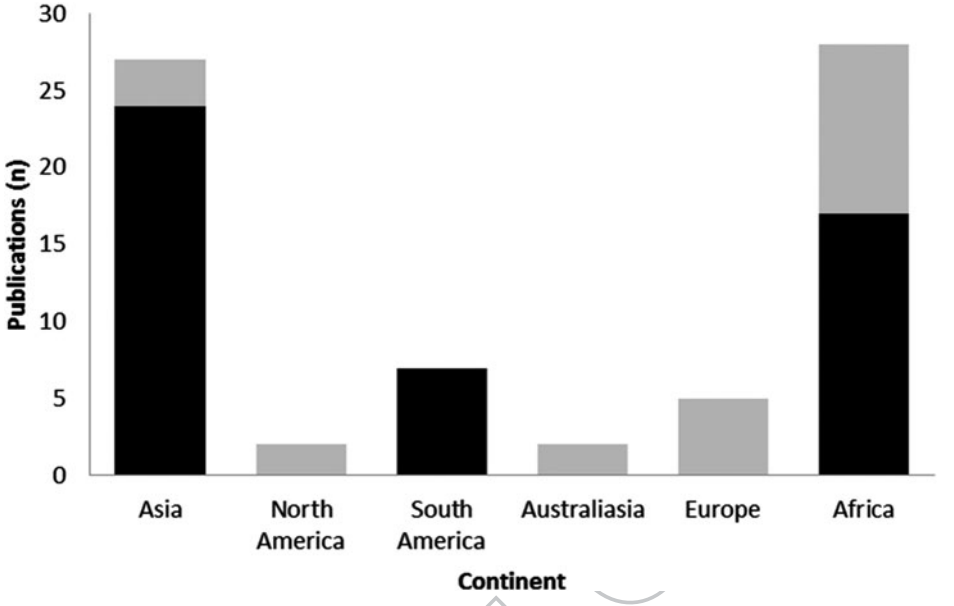


Figure 2. Categorisation by continent. In black, the share of studies evaluating an FFS is indicated and in grey the share of studies in which a different PEP is evaluated.

PROOF

et al. (2015) studied 'participatory innovation platforms', in which local stakeholders meet and collectively identify problems and solutions; Kraaijvanger, Veldkamp, and Almekinders (2016) studied 'participatory experimentation programmes', in which farmer groups participate in learning cycles consisting of experience, design, experimentation and reflection; and Schreinemachers et al. (2016) looked at 'farmer training', which refers to participatory training of farmers during a two-day workshop, followed by regular farm visits by experts and peers.

FFSs tend not to be applied in developed countries, although the PEPs used in developed countries show similarities in programme delivery, such as the inclusion of education and group activities. A total of nine evaluation studies were conducted in developed countries: Bruges and Smith examined the effect of farmer participatory research groups regarding the adoption of sustainable practices in New Zealand; Hill, Bradley, and Williams (2017) focused on the programme 'Farming Connect' in Wales, which aims to promote knowledge transfer, advice and training for farms and forestry holdings; Hennessy and Heanue (2012), Läpple and Hennessy (2015) and Läpple, Hennessy, and Newman (2013) looked at the effectiveness of discussion groups in the dairy sector in Ireland; Prager and Creaney (2017) evaluated how discussion groups in Ireland and monitor farms in Scotland work and which factors influence their success; King, Gaffiiey, and Gunton (2008) considered whether participatory action learning, a participatory extension approach for farmer groups, increases learning compared to more traditional extension approaches in Australia; Roche et al. (2015) evaluated a participatory-based experimental learning programme in which experts work with focus farms to change dairy producer behaviour to control Johne's disease; and Tamini (2011) evaluated the uptake of best management practices after participation in farmer advisory clubs in Canada.

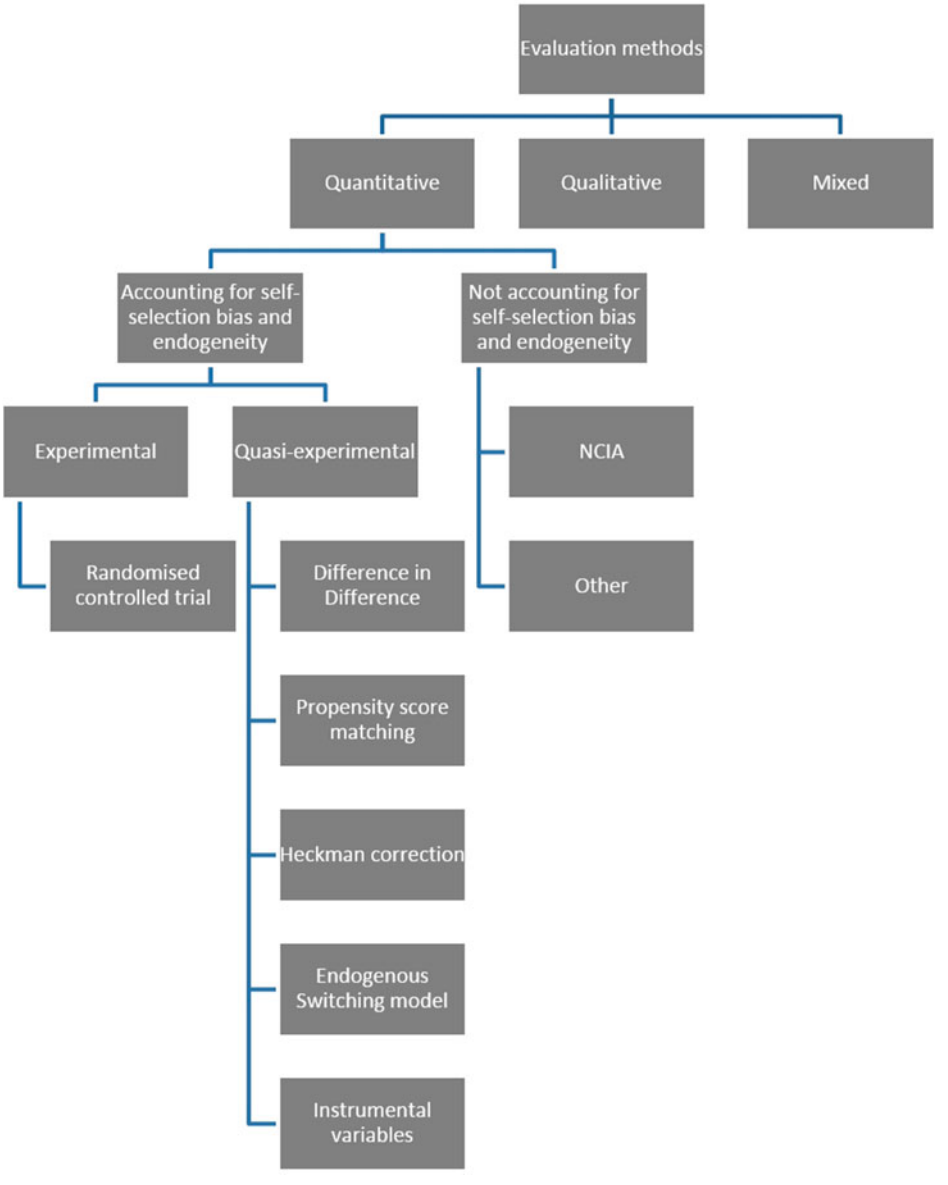
AQ3

Evaluation methods

The different evaluation methods found within the published studies of PEPs are analysed using the categories presented in Figure 3. This categorisation first divides the evaluation methods according to whether they are quantitative, qualitative or mixed methods, with the quantitative methods further subdivided according to their treatment of endogeneity.

Quantitative methods

Sixty-four of the 71 identified studies evaluated the PEP by (mainly) applying a quantitative method. These studies were further categorised (according to the categorisation in



Colour online, B/W in print

Figure 3. A categorisation of the evaluation methods used to evaluate PEPs.

Figure 3) depending on their use of (1) a method accounting for self-selection bias and endogeneity, including experimental, quasi-experimental and other approaches, or (2) a method not accounting for self-selection bias and endogeneity. An overview of the quantitative methods applied is provided in Figure 4.

Accounting for self-selection bias and endogeneity. Thirty-two studies used an experimental or quasi-experimental research design to conduct a quantitative evaluation, hereafter also referred to as 'impact evaluation', which is a widely used term in literature and addresses the effectiveness of a PEP by comparing it to the situation in the absence of the PEP (Gertler et al. 2016) and only one study used a different approach.

Experimental research design. Experimental research designs allocate participants randomly to a treatment or control group to prevent selection bias, which arises when participants and non-participants differ in characteristics that are related to participation in the programme and to the outcome (Duflo et al. 2007). Random allocation of participants is assumed to correct for any imbalance in characteristics, and the groups only differ in the presence or absence of the treatment. The effect or impact of the treatment can therefore be estimated as the difference between the control group and treatment group (Duflo and Kremer 2003; Duflo et al. 2007).

Within the evaluation methods identified, the randomised controlled trial (RCT) is the only purely experimental method, and was only used in one of the studies: Guo et al. (2015), which randomly selected treatment villages for participation in the programme in question. Although RCT optimally accounts for selection bias, the application is complicated and this is most likely the reason for the limited use of the method. The methodological challenges include: the need to plan the evaluation during the initial stages of PEP implementation; overcoming ethical restrictions which may arise when non-participants

PROOF ONLY

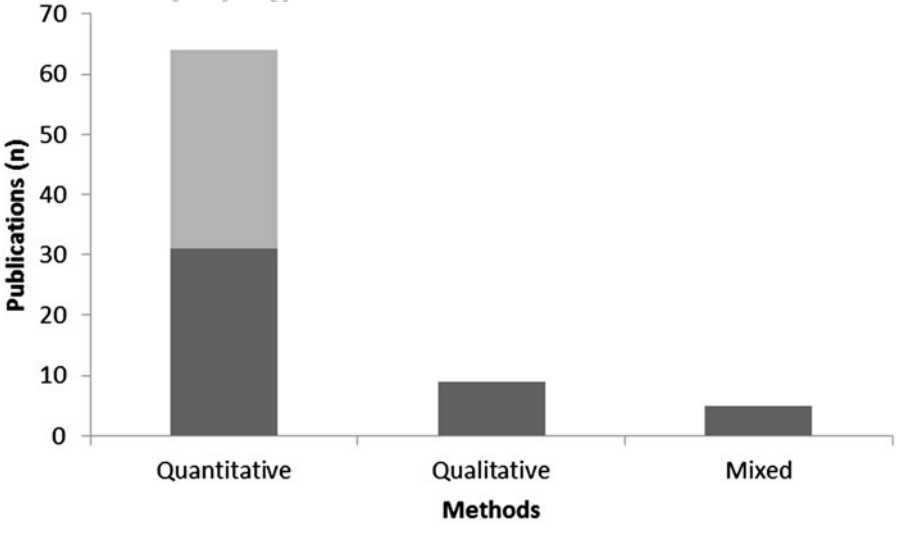


Figure 4. Categorisation of the 71 evaluation studies by quantitative, qualitative and mixed methods. The number of studies depicted is higher than the number of evaluation studies, because some studies applied multiple methods and therefore could be classified in more than one category.

are disadvantaged because of exclusion from the treatment group; accounting for spillover effects that can occur when participants exchange information with non-participants (Duflo et al. 2007). As an illustration of the difficulties with this method, Guo et al. (2015) found that the treatment villages in their study did not show a high level of comparability with the control villages, and to avoid imbalance between the treatment and control groups they applied matching techniques (see below) to account for the differences.

Quasi-experimental design. In contrast to experimental research design, quasi-experimental approaches allow non-randomised selection or self-selection of the treatment group, e.g. prospective participants can volunteer for the treatment group. Any endogeneity and self-selection bias can then be accounted for using one of several techniques: (i) difference-in-difference (DiD); (ii) propensity score matching (PSM); (iii) the Heckman correction (HC); or (iv) endogenous switching model (ESM).

The review found that difference-in-difference (DiD) was the most commonly used method, with 14 studies applying this approach. This method compares the before and after changes of a treatment group with the before and after changes of a control group, thereby controlling for differences in unobservable characteristics. The approach quantifies the difference between the groups in two steps: (i) it quantifies the average difference in outcome for the treatment and control group; and (ii) it calculates the average difference between the average changes for the treatment and control group (Bertrand, Duflo, and Sendhil 2004). An example of a study which applied DiD is Mancini et al. (2008), which measured the before and after effect of FFSs in India. An RCT was not possible because although the programme targeted specific villages, farmers' participation was on a voluntary basis. Therefore, DiD was used to account for seasonal or systematic effects other than the training effect, such as socio-economic factors, which might have favoured the participation of more progressive, wealthier and educated farmers. Togbé et al. (2014) also applied DiD to account for the non-randomised selection of farmers participating in the FFS. In Rejesus et al. (2012), the DiD approach was used to account for differences in village characteristics, because villages were selected to participate in the FFS based on access to the village, and the presence of active farmer groups.

Five studies applied PSM, which addresses endogeneity and self-selection bias by creating a propensity score for each participant based on socio-economic and other relevant characteristics, and then matches scores between members of the treatment and control groups to create groups that are as closely matched as possible (Stuart, 2010). This method is useful when baseline data and longitudinal observations are lacking (and therefore the DiD method cannot be applied), but abundant cross-sectional data for participants are available. However, a crucial assumption and potential weakness of the PSM method is that there are no unobservable characteristics that may cause a difference in results between the treatment and control group. Examples of the application of PSM can be found in Godtland et al. (2004), which applies PSM to evaluate the effect of FFSs (on knowledge of integrated pest management) with cross-sectional data, and in Schreinemachers et al. (2016), which uses PSM to quantify the effect of farmer training.

Five studies applied both PSM and DiD (Rodriguez, Rejesus, and Aragon 2007; Davis et al. 2012; e.g. Todo and Takahashi 2013) to account for systematic differences between participant and non-participant outcomes, which may continue to exist even after matching observable characteristics (Heckman, Ichimura, and Todd 1997). These differences may, for example, occur due to programme selection based on unmeasured characteristics,

PROOF ONLY

or because the treatment and control groups reside in different regions. Although combining PSM and DiD has the advantage of controlling for both observable and unobservable characteristics, it requires an extensive dataset.

One study applied the HC to account for endogenous effects (Rejesus et al. 2009); one applied an ESM (Läpple, Hennessy, and Newman 2013); and five studies applied instrumental variables (IV) (Tamini 2011; e.g. Wafula et al. 2016). All three methods require an instrument or exogenous variable, i.e. a variable that is not included in the equation of interest and via which the counterfactual can be established. However, in many situations, there is no obvious or measurable exogenous variable, which complicates the application of this method.

Not accounting for self-selection bias and endogeneity. In addition to the studies above, 32 studies calculated the effect of PEPs by conducting an impact evaluation, but did not account for endogeneity or self-selection bias either explicitly or correctly. We have categorised these studies into 'No correct impact evaluation (NCIA)' and 'Other methods'.

NCIA. Although the NCIA studies show positive results, the reliability of the findings is questionable. For instance, Tin et al. (2010) conducted a baseline and an *ex post* survey to measure change over time. However, they did not include a control group to properly account for unobservable characteristics. Furthermore, Läpple, Hennessy, and Newman (2013) provide a critique of Hennessy and Heanue's (2012) PEP evaluation, noting that a major limitation is the neglect of self-selection bias and endogeneity. This causes the under- or over-estimation of programme effects, weakening the policy relevance of this work (Läpple, Hennessy, and Newman 2013). Other studies such as Bentley et al. (2007) do not mention self-selection or endogeneity at all.

Other quantitative methods. One study applied a different quantitative methodology to assess the effect of a PEP. Bourne et al. (2017) assessed the performance of participatory advisory programmes by using social network analysis (SNA), which is the process of investigating social structures through the use of networks, as a tool to examine farmer networks. The study used SNA to analyse whether farmer networks change due to participation in an advisory programme. More specifically, it assessed the contribution towards joint decision-making, cooperation in the implementation of innovations and management of collective activities. Although the study presents a new framework to assess the PEP on these outcomes, it does not address the change in information over time, or compares the findings with a control group. Hence, we argue that in the application of this method a valid counterfactual is lacking, which undermines the findings of this study.

The absence of a reliable method to account for endogeneity in 32 published studies is a striking finding from this review and should be noted by journal editors and reviewers, as well as researchers undertaking evaluation studies.

Qualitative evaluation methods

We identified seven qualitative studies focused on PEP evaluation. This number appears low and we suspect that some qualitative studies are potentially disguised behind atypical titles and therefore are more difficult to detect by keyword search. King, Gaffiiey, and Gunton (2008) is an example of a qualitative study, which applied the convergent interviewing approach, seeking to reveal participants' reported experience of effective learning.

PROOF ONLY

The study observed a positive effect and argues 'soft' evaluation techniques such as convergent interviewing are a successful tool when faced with 'difficult to measure' PEP effects. Furthermore, Prager and Creaney (2017) combine qualitative interviews, participant observation and document analysis to draw conclusions about how participatory groups work and what influences their success.

Mixed evaluation methods

Five studies mentioned the application of both a quantitative and qualitative method. All these studies applied a qualitative method in addition to an impact assessment to measure the effect of a PEP and are thus partially already discussed in the previous sections. For instance, David and Asamoah (2011) conducted focus groups prior to the impact assessment to increase the understanding of farmers' perceptions of the impact of the FFS. They specifically asked for the impact on knowledge, decision-making skills, experimentation and knowledge diffusion, which helped in identifying suitable indicators for the impact assessment. Dolly (2009) aimed to assess 14 FFSs in Trinidad & Tobago in relation to six key extension challenges. Besides conducting interviews with individuals from the treatment and control groups, they also attended FFS meetings and included the observations during the meetings in the interpretation of the interview findings.

Not all studies explain the use of additional qualitative methods. For instance, the methodology section of Davis et al. (2012) refers to qualitative data obtained from document analysis and semi-structured interviews, but omits a transparent description of how the qualitative data are included in the study, and the results section only presents an analysis of the quantitative data. Similarly, Lund et al. (2013) undertook interviews to gain insight into the views of participants on the programme and how knowledge was acquired through programme participation. However, again only results from the quantitative data analysis are presented.

Hill, Bradley, and Williams (2017) also applied both quantitative and qualitative methods. The study included qualitative interviews with farmers to gather data on the farmers' own perceptions of the effectiveness of the PEP in question. The findings were then compared to the results from a quasi-experimental impact assessment. This showed that the qualitative approach finds a more positive outcome than the quantitative approach, which may be explained by interviewer bias and overly positive reporting in the qualitative interviews. Arguably, the use of a qualitative method for impact assessment and the subsequent comparison with a quantitative method is not a fair approach as the appropriate use of qualitative methods should be to provide a more in-depth and nuanced understanding of participant motivations and perceptions (rather than being an alternative to quantitative impact evaluation). Kraaijvanger, Veldkamp, and Almekinders (2016) used quantitative and qualitative methods to complement each other. To gain insight into which changes farmers made and whether the programme was responsible for these changes, data were collected via interviews and observations, which in turn provided detailed insight into the functioning of the programme. Overall, several studies argue that in the evaluation of participatory programmes, qualitative and quantitative methods should be used to complement each other (Murray 2000; Munro 2014).

PROOF ONLY

Outcome variables

As mentioned in the section 'Methods', PEPs aim to change farm practices, enhance social learning, increase resilience to challenges and uncertainties and sharpen farmers' management skills and decision-making abilities. We firstly found that although there is no reason to assume one aim is more important than another, the majority of the studies, with exception of Duveskog, Friis-Hansen, and Taylor (2011) and Jones, Glenna, and Weltzien (2014), include outcome variables related to the first aim: the change in farm practices. Across the 69 studies that included outcome variables related to practice change, 23 different evaluation outcome variables were identified, as shown in Appendix. The most common variable was 'knowledge acquisition', followed by 'financial performance'. In a sense, the 'knowledge acquisition' and also the 'knowledge diffusion' variables are of a different order to the other outcome variables, as they may subsume or include any of the other categories, i.e. the knowledge acquired may relate to financial management, productivity, food security, etc. Furthermore, in some evaluations, e.g. Tin et al. (2010), only knowledge acquisition is used as an indicator, because in this study, it is assumed that increased knowledge translates into a change of farming practice. Although David and Asamoah (2011) also use knowledge acquisition as a single indicator, they recognise that practice change does not only depend on knowledge, but other factors as well, such as economic conditions. This point, i.e. that knowledge acquisition does not entail impact, is widely recognised within the literature on agricultural innovation (Rogers 2003; Meijer et al. 2015). In order to address this issue, the majority of studies using knowledge acquisition as an indicator combine it with indicators measuring the actual change in practice (Godtland et al. 2004; Erbaugh et al. 2010; e.g. Mutandwa and Mpangwa 2004).

A second notable finding is that few evaluation studies focused on environmental outcomes, with only 1 considering ecological footprints, 10 considering pesticide use and 1 focusing on practice change in relation to climate change. Although this is likely to largely reflect the focus of the PEPs themselves, it nevertheless indicates that there is relatively limited research experience in evaluating the effectiveness of PEPs on environmental outcome indicators.

Thirdly, it should be noted that although most PEPs evaluated are FFSs, and FFSs have a largely uniform programme design, there is no standard set of indicators applied to their evaluation. Simpson and Owens (2002) address this issue by highlighting six key issues around FFSs in Africa: relevance and response to local concerns, knowledge acquisition, knowledge diffusion, local institutionalisation and organisational development, impact on relationships and FFS integration into existing programmes. They argue that in addition to outcome variables extra attention should be paid to these six aspects to evaluate the effectiveness of FFS programmes. Only one evaluation assessed an FFS on all these six aspects (Dolly 2009), but in 22 FFS studies knowledge diffusion and acquisition are used as outcome variables, which indicates the partial use of the six indicators proposed by Simpson and Owens (2002).

Inclusion of evaluation in initial programme design

The final aspect of the systematic review identified whether the evaluation was built into the initial PEP design, i.e. whether data collection and the evaluation method were planned

PROOF ONLY

prior to programme implementation. The reason for including this aspect in the review is that such planning is a key determinant of the type and robustness of the *ex post* evaluation that can be subsequently undertaken (Baslé 2006).

The studies that applied either an RCT or DiD method were usually planned as part of the PEP design, because both methods require data before and during the programme. However, although Larsen and Lilleør (2014) applied the DiD method, they mention the absence of a detailed evaluation plan at the beginning of their data collection. They evaluate a programme that was phased-in at different villages, and so although only cross-sectional data were available for the first phase, it was possible to gather baseline data for the second phase. In addition, although the evaluation commenced after the start of the PEP, the authors sought to avoid *ex post* bias, the cherry-picking of suitable indicators later, by basing the evaluation on previously stated aims. Davis et al. (2012) and Feder, Murgai, and Quizon (2004a) also provide a potentially useful approach for undertaking a DiD method in the absence of complete baseline data. Their baseline survey did not contain all the data required to compute the impact of the PEP, and therefore they used recall data from farmers to fill the data gaps for the situation before the implementation of the programme. Moreover, Jørs et al. (2016) did not have access to a complete longitudinal dataset either, because longitudinal data were only available for FFS and exposed farmers, but not for a control group. Therefore, DiD was only applied to make a comparison between FFS and neighbouring farmers and cross-sectional data were used to assess the programme compared to the control group.

The studies that used a cross-sectional dataset did not have the evaluation built in. For instance, Godtland et al. (2004) and Läpple and Hennessy (2015) explicitly mention the limitation in a choice of evaluation methods due to the lack of baseline data.

Conclusion and recommendations

Given the level of investment and expectation of positive outcomes from PEPs, it is important that these PEPs are properly evaluated. To identify and develop best practice, this study provides a systematic review of published evaluations in this area. Based on the findings from the review, we offer several recommendations for improving evaluation practice.

Firstly, we would like to address the large amount of studies basing the evaluation of PEPs on practice change. As mentioned in the section 'Methods', PEPs aim to change farm practices, enhance social learning, increase resilience to challenges and uncertainties and sharpen farmers' management skills and decision-making abilities. We find that evaluation studies mainly address the first aim: change in farm practices. We recommend the inclusion of the other aims as well, to provide a more holistic evaluation of the PEP.

Secondly, when conducting a quantitative evaluation, practitioners should select methods that address endogeneity and selection bias, as failure to do so undermines the reliability of the evaluation results due to under- or over-estimation of programme effects. Equally, agencies commissioning evaluations, as well as journal editors and reviewers, should request such methods to be used.

Thirdly, although a number of existing studies used some form of qualitative method alongside a quantitative method, the use of qualitative data was not well integrated or was

PROOF ONLY

treated as an alternative to quantitative methods. We recommend that qualitative data should be used to complement quantitative assessments, in order to provide additional insights into the perceptions and motivations of participants, the barriers they face, and the context in which programmes are implemented (Davies, Nutley, and Smith 2000; Montuschi 2014). It is particularly important to understand the social context of a programme when trying to extract lessons from a specific study.

Fourthly, we recommend that *ex post* evaluation should be considered in the initial design of any PEP, and the policy-maker or commissioning agency should take responsibility for ensuring that this is the case. When a quantitative evaluation is not planned prior to programme implementation, only cross-sectional data will be available for the evaluation, restricting the evaluation to one moment in time. This makes it difficult to account for unobservable characteristics. Hence, planned evaluations (prior to programme implementation) allow the establishment of robust counterfactuals and have a large influence on the quality of the impact assessment (Läpple, Hennessy, and Newman 2013).

Fifthly, we want to make a recommendation regarding the choice of indicators selected for evaluation. Although it is essential that *ex post* evaluation is considered in the initial design of any PEP, this does not mean that all the outcome indicators have to be determined by the evaluating party beforehand. In order to align with the ethos of a participatory approach, where collectively setting goals is one of the main aims, and to ensure that the evaluation findings are relevant to the on-going implementation of the programme, the participants themselves should be involved in the selection of some of the outcome indicators (Murray 2000; Bruges and Smith 2008).

Sixthly, we have observed multiple impact evaluations that only use 'knowledge acquisition' as an indicator to assess the effectiveness of a PEP. Although knowledge is recognised as an important factor in practice change, change is also highly dependent on other factors, such as economic performance. Therefore, to measure the effectiveness of a PEP, the indicator 'knowledge acquisition' should be used in combination with other indicators in order to draw conclusions on the actual change in practice.

A final observation is that relatively few evaluations of PEPs have been conducted within a developed country context, and few measure the impact of programmes on environmental outcome variables. Given the increasing emphasis on the voluntary uptake of environmental measures in the agricultural sector (e.g. The Scottish Government 2017), this suggests a gap in the literature that should be addressed by future evaluation studies.

PROOF ONLY

Acknowledgements

We would like to thank three anonymous reviewers whose suggestions have helped to improve the manuscript.

Disclosure statement

AQ5 No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Scotland's Rural College.

AQ1 **Notes on contributors**

References

Anderson, J. R., and G. Feder. 2004. "Good Intentions Extension : Agricultural and Hard Realities." *The World Bank Research Observer* 19: 41–60. doi:10.1093/wbro/lkhO13.

Baslé, M. 2006. "Strengths and Weaknesses of European Union Policy Evaluation Methods: Ex-post Evaluation of Objective 2, 1994–99." *Regional Studies* 40: 225–235. doi:10.1080/00343400600600595.

Bentley, J. W., O. Barea, S. Priou, H. Equise, and G. Thiele. 2007. "Comparing Farmer Field Schools, Community Workshops, and Radio: Teaching Bolivian Farmers About Bacterial Wilt of Potato." *J. Int. Agric. Ext. Educ.* 14: 85–95.

Bertrand, M., E. Duflo, and M. Sendhil. 2004. "How Much Should We Trust Differences-in-differences Estimates?" *The Quarterly Journal of Economics* 119: 249–275.

Black, A. 2000. "Extension Theory and Practice: A Review." *Australian Journal of Experimental Agriculture* 40: 493–502. doi:10.1071/EA97144.

Bourne, M., A. Gassner, P. Makui, A. Muller, and J. Muriuki. 2017. "A Network Perspective Filling a Gap in Assessment of Agricultural Advisory System Performance." *Journal of Rural Studies* 50: 30–44. doi:10.1016/j.jrurstud.2016.12.008.

AQ6 Braun, A. 2006. *Inventory of Farmer Study Group Initiatives in Africa*. Wageningen.: Endelea.

Bruges, M., and W. Smith. 2008. "Participatory Approaches for Sustainable Agriculture: A Contradiction in Terms?" *Agriculture and Human Values* 25: 13–23. doi:10.1007/s10460-007-9058-0.

Cristóvão, A., A. Koutsouris, and M. Kügler. 2012. "Extension Systems and Change Facilitation for Agricultural and Rural Development." In *Farming Systems Research Into the 21st Century: The New Dynamic*, edited by I. Darnhofer, D. Gibbon, and B. Dedieu, 201–227. Dordrecht: Springer.

David, S., and C. Asamoah. 2011. "The Impact of Farmer Field Schools on Human and Social Capital: A Case Study From Ghana." *The Journal of Agricultural Education and Extension* 17: 239–252. doi:10.1080/1389224X.2011.559076.

Davies, H. T. O., S. M. Nutley, and P. C. Smith. 2000. *What Works?: Evidence-based Policy and Practice in Public Services*. Bristol: Policy Press.

Davis, K. 2006. "Farmer Field Schools: A Boon or Bust for Extension in Africa?" *The Journal of Agricultural Education and Extension* 13: 91–97.

Davis, K., E. Nkonya, E. Kato, D. A. Mekonnen, M. Odendo, R. Miiro, and J. Nkuba. 2012. "Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa." *World Development* 40: 402–413. doi:10.1016/j.worlddev.2011.05.019.

Dolly, D. 2009. "An Assessment of the Implementation and Outcomes of Recent Farmer Field Schools to Improve Vegetable Production in Trinidad and Tabago." *The Journal of Agricultural Education and Extension* 16: 7–19. doi:10.5191/jiaee.2009.16201.

Duflo, E., R. Glennerster, M. Kremer, and A. Latif Jameel. 2007. *Using Randomization in Development Economics Research: A Toolkit (No. 333)*.

Duflo, E., and M. Kremer. 2003. "Use of Randomization in the Evaluation of Development Effectiveness." World Bank Operations Evaluation Department (OED) Conference on Evaluation and Development Effectiveness, 37. doi: 10.1017/CBO9781107415324.004.

Duveskog, D., E. Friis-Hansen, and E. W. Taylor. 2011. "Farmer Field Schools in Rural Kenya: A Transformative Learning Experience." *Journal of Development Studies* 47: 1529–1544. doi:10.1080/00220388.2011.561328.

Erbaugh, J. M., J. Donnermeyer, M. Amujal, and M. Kidoido. 2010. "Assessing the Impact of Farmer Field School Participation on IPM Adoption in Uganda." *The Journal of Agricultural Education and Extension* 17: 5–17. doi:10.5191/jiaee.2010.17301.

FAO. 2017. "Farmer Field School Approach [www Document]". Accessed August 22, 2017. http://www.fao.org/agriculture/ippm/programme/ffs-approach/en/.

PROOF ONLY

Faure, G., Y. Desjeux, and P. Gasselin. 2012. "New Challenges in Agricultural Advisory Services From a Research Perspective: A Literature Review, Synthesis and Research Agenda." *The Journal of Agricultural Education and Extension* 18: 461–492. doi:10.1080/1389224X.2012.707063.

Feder, G., R. Murgai, and J. B. Quizon. 2004a. "Sending Farmers Back to School: The Impact of Farmer Field Schools in Indonesia." *Review of Agricultural Economics* 26: 45–62. doi:10.1111/j.1467-9353.2003.00161.x.

Feder, G., R. Murgai, and J. B. Quizon. 2004b. "The Acquisition and Diffusion of Knowledge: The Case of Pest Management Training in Farmer Field Schools, Indonesia." *Journal of Agricultural Economics* 55: 221–243. doi:10.1111/j.1477-9552.2004.tb00094.x.

Gertler, P. J., S. Martinez, P. Premand, L. B. Rawlings, and C. M. J. Vermeersch. 2016. *Impact Evaluation in Practice*. 2nd ed. Washington, DC: The World Bank.

Godtland, E.M., Sadoulet, E., De Janvry, A., Murgai, R., and Ortiz, O. 2004. "The Impact of Farmer Field Schools on Knowledge and Productivity: A Study of Potato Farmers in the Peruvian Andes." *Economic Development and Cultural Change* 53: 63–92. doi:10.1086/423253.

Guo, M., X. Jia, J. Huang, K. B. Kumar, and N. E. Burger. 2015. "Farmer Field School and Farmer Knowledge Acquisition in Rice Production: Experimental Evaluation in China." *Agriculture, Ecosystems & Environment* 209: 100–107. doi:10.1016/j.agee.2015.02.011.

Heckman, J. J., H. Ichimura, and P. E. Todd. 1997. "Matching Evidence Job As an Econometric Estimator: Evidence From Evaluating a Job Training Programme." *The Review of Economic Studies* 64: 605–654. doi:10.1111/1467-937X.00044.

Hennessy, T., and K. Heanue. 2012. "Quantifying the Effect of Discussion Group Membership on Technology Adoption and Farm Profit on Dairy Farms." *The Journal of Agricultural Education and Extension* 18: 41–54. doi:10.1080/1389224X.2012.638784.

Hill, B., D. Bradley, and E. Williams. 2017. "Evaluation of Knowledge Transfer; Conceptual and Practical Problems of Impact Assessment of Farming Connect in Wales." *Journal of Rural Studies* 49: 41–49. doi:10.1016/j.jrurstud.2016.11.003.

Jones, K., L. L. Glenna, and E. Weltzien. 2014. "Assessing Participatory Processes and Outcomes in Agricultural Research for Development From Participants' Perspectives." *Journal of Rural Studies* 35: 91–100. doi:10.1016/j.jrurstud.2014.04.010.

Jørs, E., F. Konradsen, O. Huici, R. C. Morant, J. Volk, and F. Lander. 2016. "Impact of Training Bolivian Farmers on Integrated Pest Management and Diffusion of Knowledge to Neighboring Farmers." *Journal of Agromedicine* 21: 200–208. doi:10.1080/1059924X.2016.1143428.

King, C., J. Gaffiiey, and J. Gunton. 2008. "Does Participatory Action Learning Make a Difference? Perspectives of Effective Learning Tools and Indicators From the Conservation Cropping Group in North Queensland, Australia." *The Journal of Agricultural Education and Extension* 7: 133–146. doi:10.1080/13892240108438821.

Klerkx, L., F. Landini, and H. Santoyo-Cortés. 2016. "Agricultural Extension in Latin America: Current Dynamics of Pluralistic Advisory Systems in Heterogeneous Contexts." *The Journal of Agricultural Education and Extension* 22: 389–397. doi:10.1080/1389224X.2016.1227044.

Kraaijvanger, R., T. Veldkamp, and C. Almekinders. 2016. "Considering Change: Evaluating Four Years of Participatory Experimentation with Farmers in Tigray (Ethiopia) Highlighting Both Functional and Human-social Aspects." *Agricultural Systems* 147: 38–50. doi:10.1016/j.agsy.2016.05.001.

Larsen, A. F., and H. B. Lilleør. 2014. "Beyond the Field: The Impact of Farmer Field Schools on Food Security and Poverty Alleviation." *World Development* 64: 843–859. doi:10.1016/j.worlddev.2014.07.003.

Läpple, D., and T. Hennessy. 2015. "Assessing the Impact of Financial Incentives in Extension Programmes Evidence From Ireland." *Journal of Agricultural Economics* 66: 781–795. doi:10.1111/1477-9552.12108.

Läpple, D., T. Hennessy, and C. Newman. 2013. "Quantifying the Economic Return to Participatory Extension Programmes in Ireland: An Endogenous Switching Regression Analysis." *Journal of Agricultural Economics* 64: 467–482. doi:10.1111/1477-9552.12000.

PROOF ONLY

Lund, T., I. Nyborg, M. H. Rahman, and M. G. Sathre. 2013. "Social Impacts of IPM-FFS on Urban and Peri-Urban Vegetable Producers in Cotonou, Benin." *African Journal of Food, Agriculture, Nutrition and Development* 13: 7727–7745. doi:10.1017/S1742758410000020.

Mancini, F., A. J. Termorshuizen, J. L. S. Jiggins, and A. H. C. van Bruggen. 2008. "Increasing the Environmental and Social Sustainability of Cotton Farming Through Farmer Education in Andhra Pradesh, India." *Agricultural Systems* 96: 16–25. doi:10.1016/j.agsy.2007.05.001.

Meijer, S. S., D. Catacutan, O. C. Ajayi, G. W. Sileshi, and M. Nieuwenhuis. 2015. "The Role of Knowledge, Attitudes and Perceptions in the Uptake of Agricultural and Agroforestry Innovations among Smallholder Farmers in Sub-Saharan Africa." *International Journal of Agricultural Sustainability* 13: 40–54. doi:10.1080/14735903.2014.912493.

Montuschi, E. 2014. *Scientific Objectivity, in: Philosophy of Social Science: A New Introduction*. Oxford: Oxford University Press. 123–144.

Munro, E. 2014. "Evidence-based Policy." In *Philosophy of Social Science: A New Introduction*, edited by N. Cartwright and E. Montuschi, 48–67. Oxford: Oxford University Press.

Murray, P. 2000. "Evaluating Participatory Extension Programs: Challenges and Problems." *Australian Journal of Experimental Agriculture* 40: 519–526. doi:10.1071/EA99079.

Mutandwa, E., and J. Mpangwa. 2004. "An Assessment of the Impact of Farmer Field Schools on Integrated Pest Management Dissemination and Use: Evidence From Smallholder Cotton Farmers in the Lowveld Area of Zimbabwe." *African Journal of Sustainable Development* 6: 24–31.

Pamuk, H., E. Bulte, and A. A. Adekunle. 2014. "Do Decentralized Innovation Systems Promote Agricultural Technology Adoption? Experimental Evidence From Africa." *Food Policy* 44: 227–236. doi:10.1016/j.foodpol.2013.09.015.

Pamuk, H., E. Bulte, A. Adekunle, and A. Diagne. 2015. "Decentralised Innovation Systems and Poverty Reduction: Experimental Evidence from Central Africa." *European Review of Agricultural Economics* 42: 99–127. doi:10.1093/erae/jbu007.

Prager, K., and R. Creaney. 2017. "Achieving On-farm Practice Change Through Facilitated Group Learning: Evaluating the Effectiveness of Monitor Farms and Discussion Groups." *Journal of Rural Studies* 56: 1–11. doi:10.1016/j.jrurstud.2017.09.002.

Pretty, J. N., and R. Chambers. 2003. "Toward a Learning Paradigm: New Professionalism and Institutions for Agriculture." In *Rethink. Sustain. Power, Knowledge, Institutions (Evolving Values a Capital World)*, 189.

Rejesus, R. M., M. E. M. Mutuc, M. Yasar, A. V. Lapitan, F. G. Palis, and T. T. N. Chi. 2012. "Sending Vietnamese Rice Farmers Back to School: Further Evidence on the Impacts of Farmer Field Schools." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 60: 407–426. doi:10.1111/j.1744-7976.2011.01242.x.

Rejesus, R. M., F. G. Palis, A. V. Lapitan, T. T. N. Chi, and M. Hossain. 2009. "The Impact of Integrated Pest Management Information Dissemination Methods on Insecticide Use and Efficiency: Evidence from Rice Producers in South Vietnam." *Review of Agricultural Economics* 31, doi:10.1111/j.1467-9353.2009.01468.x.

Roche, S. M., A. Jones-Bitton, M. Meehan, M. Von Massow, and D. F. Kelton. 2015. "Evaluating the Effect of Focus Farms on Ontario Dairy Producers' Knowledge, Attitudes, and Behavior Toward Control of Johne's Disease." *Journal of Dairy Science* 98: 5222–5240. doi:10.3168/jds.2014-8765.

Rodriguez, D. G. P., R. M. Rejesus, and C. T. Aragon. 2007. "Impacts of an Agricultural Development Program for Poor Coconut Producers in the Philippines: An Approach Using Panel Data and Propensity Score Matching Techniques." *Journal of Agricultural and Resource Economics*. doi:10.2307/40982695.

Rogers, E. M. 2003. *Diffusion of Innovations*. New York: Free Press.

Schreinemachers, P., M. H. Wu, M. N. Uddin, S. Ahmad, and P. Hanson. 2016. "Farmer Training in Off-season Vegetables: Effects on Income and Pesticide Use in Bangladesh." *Food Policy* 61: 132–140. doi:10.1016/j.foodpol.2016.03.002.

Scoones, I., and J. Thompson. 2009. *Farmer First Revisited: Innovation for Agricultural Research and Development*. 1st ed. Rugby: Practical Action.

Stuart, E.A. 2010. Matching Methods for Causal Inference: A Review and a Look Forward. Statistical Science 25: 1-21. doi:10.1214/09-STS313.

PROOF ONLY

The Scottish Government. 2017. *The Draft Third Report on Policies and Proposals 2017-2032*.
AQ7 Edinburgh. : The Scottish Government.
Simpson, B. M., and M. Owensb56. 2002. "Farmer Field Schools and the Future of Agricultural Extension in Africa 3rd Runner-up Outstanding." Paper presented at the 18th annual association for International Agricultural and Extension Education Conference, Durban, May 26–30, 9: 29–36. doi:10.5191/jiaee.2002.09204.
Tamini, L. D. 2011. "A Nonparametric Analysis of the Impact of Agri-environmental Advisory Activities on Best Management Practice Adoption: A Case Study of Quebec." *Ecological Economics* 70: 1363–1374. doi:10.1016/j.ecolecon.2011.02.012.
Tin, H. Q., P. C. Struik, L. L. Price, N. P. Tuyen, N. P. Hoan, and H. Bos. 2010. "Increase of Farmers' Knowledge Through Farmer Seed Production Schools in Vietnam as Assessed on the Basis of Ex-ante and Ex-post Tests." *The Journal of Agricultural Education and Extension* 16: 229–247. doi:10.1080/1389224X.2010.489766.
Todo, Y., and R. Takahashi. 2013. "Impact of Farmer Field School on Agricultural Impact and Skills: Evidence from an Aid-funded Project in Rural Ethiopia." *Journal of International Development*, 362–381. doi:10.1002/jid.
Togbé, C. E., R. Haagsma, A. K. N. Aoudji, and S. D. Vodouhê. 2014. "Effect of Participatory Research on Farmers" Knowledge and Practice of IPM: The Case of Cotton in Benin." *The Journal of Agricultural Education and Extension* 8622: 1–20. doi:10.1080/1389224X.2014.971829.
AQ8 United Nations. 2018. *World Economic Situation and Prospects 2018*. New York. : United Nations.
Vaarst, M., D. K. Byarugaba, J. Nakavuma, and C. Laker. 2007. "participatory Livestock Farmer Training for Improvement of Animal Health in Rural and Peri-urban Smallholder Dairy Herds in Jinja, Uganda." *Tropical Animal Health and Production* 39: 1–11. doi:10.1007/s11250-006-4439-8.
Van den Berg, H. 2004. *IPM Farmer Field Schools : A Synthesis of 25 Impact Evaluations*. Office 53.
Van Den Berg, H., and J. Jiggins. 2007. Investing in Farmers – The Impacts of Farmer Field Schools in Relation to Integrated Pest Management. *World Development* 35: 663–686. doi:10.1016/j.worlddev.2006.05.004
Wafula, L., J. Oduol, W. Oluoch-Kosura, J. Muriuki, J. Okello, and J. Mowo. 2016. "Does Strengthening Technical Capacity of Smallholder Farmers Enhance Adoption of Conservation Practices? The Case of Conservation Agriculture with Trees in Kenya." *Agroforestry Systems* 90: 1045–1059. doi:10.1007/s10457-015-9882-y.
~~World Bank. 2011. *Impact Evaluations in Agriculture. An Assessment of the Evidence*. Washington, DC.~~
AQ9 IEG (Independent Evaluation Group). 2011. Impact Evaluations in Agriculture: An Assessment of the Evidence. Washington, DC: World Bank.

PROOF ONLY

Appendix

AQ10 **Table A1.** Overview of the evaluation studies included in the systematic review, categorised by the aspects studied.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
1	Bekele et al. (2013)	The impact of group based training approaches on crop yield, household income and adoption of pest management practices in the smallholder horticultural subsector of Kenya	*Journal of Sustainable Development in Africa*	Kenya	FFS and common interest groups (CIGs)	Quantitative evaluation: PSM	Yield; income; pest management	No
2	Benin et al. 2011	Returns to spending on agricultural extension: the case of the National Agricultural Advisory Services (NAADS) program of Uganda	*Agricultural Economics*	Uganda	Participatory advisory services (programme name: National Agricultural Advisory Services)	Quantitative evaluation: PSM & DiD	Income	No
3	Bentley et al. (2007)	Comparing farmer field schools, community workshops, and radio: teaching Bolivean farmers about Bacterial wilt of potato	*Journal of International Agricultural and Extension Education*	Bolivia	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; crop management; use of healthy seed; crop rotation and incorporation of manure; knowledge diffusion	Yes
4	Bhandari (2012)	Integrated pest management farmer field school for sustainable agriculture	*International Journal of Agricultural Science, Research and Technology*	Nepal	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; knowledge diffusion	No
5	Bourne et al. (2017)	A network perspective filling a gap in assessment of agricultural advisory system performance	*Journal of Rural Studies*	Rwanda, Kenya, Tanzania	Participatory advisory services	Quantitative evaluation: other	Information flow; capacity for collective action	No
6	Bruges & Smith (2007)	Participatory approaches for sustainable agriculture: a contradiction in terms?	*Agriculture and Human Values*	New Zealand	Participatory farmer research groups	Qualitative evaluation	Potential and constraints of participatory approaches	No

PROOF ONLY

7	Bunyatta et al. (2006)	Farmer Field School Effectiveness for Soil and Crop Management Technologies in Kenya	*Journal of International Agricultural and Extension Education*	Kenya	FFS	Quantitative evaluation: NCIA	knowledge acquisition; knowledge diffusion	No
8	Cavatassi et al. (2011)	How do agricultural programmes alter crop production?	*Journal of Agricultural Economics*	Ecuador	FFS	Quantitative evaluation: PSM	Production technology changes; yield	No
9	David and Asamoah (2011)	The impact of farmer field schools on human and social capital. A case study from Ghana	*The Journal of Agricultural Education and Extension*	Ghana	FFS	Quantitative evaluation: NCIA	knowledge acquisition; experimental skills; social capital	No
10	Davis et al. (2012)	Impact of farmer field school on agricultural productivity and poverty in East Africa	*World Development*	Kenya, Tanzania, Uganda	FFS	Quantitative evaluation: PSM and DiD	Productivity; income	Partly: Baseline survey conducted, but incomplete. Hence, recall data are used
11	Dinpanah et al. (2010)	Analysis of effect of farmer field school approach on adoption of biological control on rice producer' characteristics in Iran	*American-Eurasian Journal of Agricultural and Environmental Science*	Iran	FFS	Quantitative evaluation: NCIA	Knowledge acquisition	No
12	Dolly (2009)	An assessment of the implementation and outcomes of recent farmer field schools to improve vegetable production in Trinidad and Tabago	*Journal of International Agricultural and Extension Education*	Trinidad & Tabago	FFS	Quantitative evaluation: NCIA	Relevance and response to local concerns; knowledge acquisition; knowledge diffusion; local institutionalisation and organisational development; impact on relationships; FFS integration into existing programmes	No
13	Duveskog, Friis-Hansen, and Taylor (2011)	Farmer field schools in rural Kenya: a transformative learning experience	*Journal of Development Studies*	Kenya	FFS	Qualitative evaluation	Impact of programme on farmers' daily lives, social learning	No

(*Continued*)

PROOF ONLY

Table A1. Continued.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
14	Erbaugh et al. (2001)	Evaluating farmers' knowledge and awareness of integrated pest management (IPM): assessment of the IPM collaborative research support project in Uganda	*Journal of International Agricultural and Extension Education*	Uganda	FFS	Quantitative evaluation: NCIA	Knowledge acquisition	No
15	Erbaugh et al. (2010)	Assessing the impact of farmer field school participation on IPM adoption in Uganda	*Journal for International Agricultural and Extension Education*	Uganda	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; pesticide use	No
16	Feder, Murgai, and Quizon (2004a)	Sending farmers back to school: the impact of farmer field schools in Indonesia	*Review of Agricultural Economics*	Indonesia	FFS	Quantitative evaluation: DiD	Yield; pesticide use	Partly: Baseline survey conducted, but the final evaluation required additional questions
17	Feder, Murgai, and Quizon (2004b)	The acquisition and diffusion of knowledge: the case of pest management training in farmer field schools, Indonesia	*Journal of Agricultural Economics*	Indonesia	FFS	Quantitative evaluation: DiD	Knowledge acquisition; knowledge diffusion	Yes
18	Godtland et al. (2004)	The impact of farmer-field-schools on knowledge and productivity: a study of potato farmers in the Peruvian Andes	*Economic Development and Cultural Change*	Peru	FFS	Quantitative evaluation: PSM	Productivity; knowledge acquisition	No
19	Gockowski et al. (2010)	An evaluation of farmer field school induced changes in Ghanaian cocoa production	*Journal of International Agricultural and Extension Education*	Ghana	FFS	Quantitative evaluation: NCIA	Production; pesticide use; crop management practice	No

PROOF ONLY

20	Guo et al. (2015)	Farmer field school and farmer knowledge acquisition in rice production: experimental evaluation in China	*Agriculture, Ecosystems and Environment*	China	FFS	Quantitative evaluation: RCT	knowledge acquisition	Yes
21	Hennessy and Heanue (2012)	Quantifying the effect of discussion group membership on technology adoption and farm profit on dairy farms	*The Journal of Agricultural Education and Extension*	Ireland	Farmer discussion groups	Quantitative evaluation: NCIA	technology adoption; profit levels	No
22	Hill, Bradley, and Williams (2017)	Evaluation of knowledge transfer; conceptual and practical problems of impact assessment of farming connect in Wales	*Journal of Rural Studies*	United Kingdom	Farmer discussion groups (programme name: Farming Connect)	Quantitative evaluation: DiD	Income; turnover; farm sales; farm profits; farm labour	Yes
23	Istriningsih & Dewi (2015)	Performance of soybean's farmer field school-integrated crop management in central Java and West Nusa Tenggara provinces, Indonesia	*Asian Journal of Agriculture and Development*	Indonesia	FFS	Quantitative evaluation: NCIA	Productivity	No
24	Jones, Glenna, and Weltzien (2014)	Assessing participatory processes and outcomes in agricultural research for development from participants' perspective	*Journal of Rural Studies*	Mali, Niger, Burkina Faso	Participatory training groups (programme name: Participatory Plant Breeding Project)	Qualitative evaluation	Strengthening of practical and strategic outputs to contribute to food security, social learning, empowering participants	No
25	Jors et al. (2014)	Do Bolivian small holder farmers improve and retain knowledge to reduce occupational pesticide poisonings after training on integrated pest management?	*Environmental Health*	Bolivia	FFS	Quantitative evaluation: NCIA	knowledge acquisition; pesticide use	Yes
26	Jørs et al. (2016)	Impact of training Bolivian farmers on integrated pest management and diffusion of knowledge to neighboring farmers	*Journal of Agromedicine*	Bolivia	FFS	Quantitative evaluation: NCIA	Knowledge diffusion; pesticide use	Yes, but the control group was not included in the baseline study. This included only the FFS farmers and neighbouring farmers.

(*Continued*)

PROOF ONLY

Table A1. Continued.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
27	Kadiyala et al. (2016)	Adopting agriculture platforms for nutrition: A case study of a participatory, video-based agricultural extension platform in India	*Plos One*	India	Agricultural self-help discussion groups	Qualitative evaluation	Nutrition behaviour	No
28	Kangmennaang et al. (2017)	Impact of a participatory agroecological development project on household wealth and food security in Malawi	*Food Security*	Malawi	Farmer to farmer extension (programme name: Farmer to Farmer Agroecology project)	Quantitative evaluation: PSM and DiD	Household income; food security	Yes
29	King, Gaffiiey, and Gunton (2008)	Does participatory action learning make a difference? Perspectives of effective learning tools and indicators from the conservation cropping group in North Queensland, Australia	*The Journal of Agricultural Education and Extension*	Australia	Participatory action learning	Qualitative evaluation	-	No
30	Kraaijvanger, Veldkamp, and Almekinders (2016)	Considering change: evaluating four years of participatory experimentation with farmers in Tigray (Ethiopia) highlighting both functional and human-social aspects	*Agricultural Systems*	Ethiopia	Farmer experimentation groups	Quantitative evaluation: NCIA; interviews and observations	Functional and human-social aspects	Yes
31	Läpple, Hennessy, and Newman (2013)	Quantifying the economic return to participatory extension programmes in Ireland: an Endogenous Switching regression analysis	*Journal of Agricultural Economics*	Ireland	Farmer discussion groups (programme name: Dairy Efficiency Programme)	Quantitative evaluation: ESM	gross margins	No
32	Läpple and Hennessy (2015)	Assessing the impact of financial incentives in extension programmes: evidence from Ireland	*Journal of Agricultural Economics*	Ireland	Farmer discussion groups (programme name: Dairy Efficiency Programme)	Quantitative evaluation: PSM	Yield; gross margins	No

PROOF ONLY

33	Larsen and Lilleør (2014)	Beyond the field: the impact of farmer field schools on food security and poverty alleviation	*World Development*	Tanzania	FFS	Quantitative evaluation: DiD	Uptake of proposed technology options, i.e. crops, poultry breeds, goat breeds; development outcomes, i.e. frequency of meat and egg consumption	Yes
34	Lund et al. (2010)	Farmer field school-IPM impacts on urban and peri-urban vegetable producers in Cotonou, Benin	*International Journal of Tropical Insect Science*	Benin	FFS	Quantitative evaluation: DiD	pesticide use; knowledge acquisition; adoption of integrated pest management options	Yes
35	Mancini et al. (2007)	Evaluating cotton integrated pest management (IPM) farmer field school outcomes using the sustainable livelihoods approach in India	*Experimental Agriculture*	India	FFS	Quantitative evaluation: NCIA	Capital stocks: respondents were asked to value their capital stocks (natural, social, human, physical and financial capital) on a scale from 0 (no stock) to 5.	No, there is measurement over time, but with help of recall data
36	Mancini & Jiggins (2008)	Appraisal of methods to evaluate farmer field schools	*Development in Practice*	India	FFS	Quantitative evaluation: DiD	ecological footprint; occupational hazard of cotton production; effects of integrated pest management adoption on labour allocation; management practices and livelihood	Yes
37	Mariyono et al. (2013)	Farmer field schools on Chilli Peppers in Aceh, Indonesia: activities and impacts	*Agroecology and Sustainable Food Systems*	Indonesia	FFS	Quantitative evaluation: Not explicitly mentioned, but shows similarities to DiD	knowledge acquisition	No, they assume an equal baseline for all participants
38								
39	Mataia et al. (2015)	Impact of farmer field school – Palay Check in the integrated rice areas in the Philippines	*Philippine Journal of Crop Science*	Philippines	FFS	Quantitative evaluation: NCIA	Productivity; yield	Yes, but do not include a control group. Only measure difference over time for treatment group.

(*Continued*)

PROOF ONLY

Table A1. Continued.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
39	Mauceri et al. (2007)	Effectiveness of integrated pest management dissemination techniques: a case study of potato farmers in Carchi, Ecuador	*Journal of Agricultural and Applied Economics*	Ecuador	FFS	Quantitative evaluation: IV	Knowledge acquisition; knowledge adoption	No
40	Mfitumukiza et al. (2017)	Assessing the farmer field school's diffusion of knowledge and adaptation to climate change by smallholder farmers in Kiboga District, Uganda	*Journal of Agricultural Extension and Rural Development*	Uganda	FFS	Quantitative evaluation: NCIA	Knowledge diffusion; uptake of climate change adaptation measures	No
41	Moumani-Helali & Ahmadpour (2013)	Impact of farmer's field school approach on knowledge, attitude and adoption of rice producers toward biological control: the case of Babol Townships, Iran	*World Applied Sciences Journal*	Iran	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; knowledge adoption	No
42	Mutandwa and Mpangwa (2004)	An assessment of the impact of farmer field schools on integrated pest management dissemination and use: evidence from small holder cotton farmers in the Lowveld area of Zimbabwe	*Journal of Sustainable Development in Africa*	Zimbabwe	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; income	Yes
43	Olanya et al. (2010)	Comparative assessment of pest management practices in potato production at farmer field schools	*Food Security*	Uganda	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; late blight development; perceptions of pest management and agronomic practices	Yes
44	Pamuk, Bulte, and Adekunle (2014)	Do decentralized innovation systems promote agricultural technology adoption? Experimental evidence from Africa	*Food Policy*	Several regions in Africa	Innovation platform (programme name: Sub-Sahara African Challenge Program)	Quantitative evaluation: DiD	Adoption of innovations relating to soil and water management, soil fertility management, crop management, post-harvest storage	Yes

PROOF ONLY

45	Pamuk et al. (2015)	Decentralised innovation systems and poverty reduction: experimental evidence from Central Africa	*European Review of Agricultural Economics*	Rwanda; Uganda	Innovation platform	Quantitative evaluation: DiD	Poverty alleviation; food consumption	Yes
46	Pedzisa et al. (2010)	An evaluation of the use of participatory processes in wide-scale dissemination of research in micro dosing and conservation agriculture in Zimbabwe	*Research Evaluation*	Zimbabwe	Participatory action research	Quantitative evaluation: NCIA	Adoption of innovations relating to fertilizer use, nutrient management, tillage and mulching	No
47	Prager and Creaney (2017)	Achieving on-farm practice change through facilitated group learning: evaluating the effectiveness of monitor farms and discussion groups	*Journal of Rural Studies*	Ireland and Scotland	Discussion groups; monitor farms	Qualitative evaluation	Qualitative assessment of the levels of learning, knowledge exchange and practice change	No
48	Rahman & Hamid (2012)	Impact of FFS on farmers' adoption of IPM options for tomato: a case study from the Gezira State, Sudan	*International Journal of Development and Sustainability*	Sudan	FFS	Quantitative evaluation: NCIA	Adoption of practices: land preparation; sewing methods; fertiliser use; intercropping; use of soft chemicals; weed control; irrigation; stoppage of spraying pesticides at 50% fruit setting	No
49	Rejesus et al. (2009)	The impact of integrated pest management information dissemination methods on insecticide use and efficiency: evidence from rice producers in South Vietnam	*Review of Agricultural Economics*	Vietnam	FFS	Quantitative evaluation: Heckman estimator	Pesticide use; efficiency	No
50	Rejesus et al. (2012)	Sending Vietnamese rice farmers back to school: further evidence on the impact of farmer field schools	*Canadian Journal of Agricultural Economics*	Vietnam	FFS	Quantitative evaluation: DiD	Yield; pesticide use; knowledge acquisition	Yes

(*Continued*)

PROOF ONLY

Table A1. Continued.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
51	Ricker-Gilbert et al. (2008)	Cost-effectiveness of alternative integrated pest management extension methods: an example from Bangladesh	*Review of Agricultural Economics*	Bangladesh	FFS	Quantitative evaluation: IV	Knowledge acquisition; knowledge dissemination	No
52	Rodriguez, Rejesus, and Aragon (2007)	Impacts of an agricultural development program for poor coconut producers in the Philippines: an approach using panel data and propensity score matching technique	*Journal of Agricultural and Resource Economics*	Philippines	Farmer training groups (part of MAUNLAD programme)	Quantitative evaluation; PSM and DiD	Income	Yes
53	Rola et al. (2002)	Do farmer field school graduates retain and share what they learn? An investigation in Iloilo, Philippines	*Journal of International Agricultural and Extension Education*	Philippines	FFS	Quantitative evaluation: NCIA	Knowledge acquisition; knowledge diffusion	No, but use data collected by a study of Rola et al. (1998)
54	Roche et al. (2015)	Evaluating the effect of focus farms on Ontario dairy producers' knowledge, attitudes, and behaviour toward control of Johne's Disease	*Journal of Dairy Science*	Canada	Participatory-based experimental learning programme (Programme name: Ontario Focus Farms)	Quantitative evaluation: NCIA	Knowledge acquisition; attitudes; behaviour	Yes
55	Roy et al. (2015)	Effectiveness of farmer field school for soil and crop management	*International Journal of Sciences: Basic and Applied Research*	Bangladesh	FFS	Quantitative evaluation: NCIA	Perception of farmers on programme	No
56	Rustam et al. (2010)	Effect of integrated pest management farmer field school (IPMFFS) on farmers' knowledge, farmers groups' ability, process of adoption and diffusion of IPM in Jember district	*Journal of Agricultural Extension and Rural Development*	Indonesia	FFS	Quantitative evaluation: NCIA	Knowledge diffusion; knowledge acquisition	Partly, there is a baseline study, but contains not all indicators

PROOF ONLY

57	Schreinemachers et al. (2016)	Farmer training in off-season vegetables: effects on income and pesticide use in Bangladesh	*Food Policy*	Bangladesh	Farmer training	Quantitative evaluation: PSM	Crop output; land productivity; farm profit; total per capita income; pesticide use	No
58	Sharma et al. (2015)	Quantitative evaluation indicators of an integrated pest management program in vegetable crops in the subtropical region of Jammu and Kashmir, India	*Crop Protection*	India	FFS	Quantitative evaluation: NCIA	Pesticide use	No
59	Sharma & Peshin (2016)	Impact of integrated pest management of vegetables on pesticide use in subtropical Jammu, India	*Crop Protection*	India	FFS	Quantitative evaluation: DiD	Pesticide use	Yes
60	Siddiqui et al. (2012)	Assessing the impact of integrated pest management farmer field schools (IPM-FFSs) on acquisition of farmers' knowledge regarding use of pesticide, nutrient management and confidence in decision-making process	*Pakistan Journal of Life and Social Sciences*	Pakistan	FFS	Quantitative evaluation: NCIA	knowledge acquisition	No
61	Snapp et al. (2002)	Farmer and researcher partnerships in Malawi: developing soil fertility technologies for the near-term and far-term	*Experimental Agriculture*	Malawi	Participatory action research	Quantitative evaluation: NCIA	Productivity; farmer perceptions; economic performance	Yes
62	Tamini (2011)	A nonparametric analysis of the impact of agri-environmental advisory activities on best management practice adoption: a case study of Quebec	*Ecological Economics*	Canada	Farmer advisory clubs	Quantitative evaluation: IV	Adoption of best management practices: use of mineral fertiliser; hydraulic infrastructure; conservation tillage; riparian buffer	No

(*Continued*)

PROOF ONLY

Table A1. Continued.

Nr	Authors	Title	Journal	Location	Programme delivery	Methods	Outcome variables	Inclusion evaluation
63	Tin et al. (2010)	Increase of farmers' knowledge through farmer seed production schools in Vietnam as assessed on the basis of *ex ante* and *ex post* tests	*The Journal of Agricultural Education and Extension*	Vietnam	FFS	Quantitative evaluation: NCIA	Knowledge acquisition	Yes
64	Todo and Takahashi (2013)	Impact of farmer field schools on agriculture income and skills: evidence from an aid-funded project in rural Ethiopia	*Journal of International Development*	Ethiopia	FFS	Quantitative evaluation: PSM and DiD	Income	No
65	Togbé et al. (2014)	Effect of participatory research on farmers' knowledge and practice of IPM: The case of cotton in Benin	*The Journal of Agricultural Education and Extension*	Benin	FFS	Quantitative evaluation: DiD	Knowledge acquisition; pesticide use	Yes
66	Vaarst et al. (2007)	Participatory livestock farmer training for improvement of animal health in rural and peri-urban smallholder dairy herds in Jinja, Uganda	*Tropical Animal Health and Production*	Uganda	Participatory farmer training groups (based on FFS approach)	Qualitative evaluation	Improved practices: increased milk production; reduction of Mastitis incidence	No
67	Wafula et al. (2016)	Does strengthening technical capacity of smallholder farmers enhance adoption of conservation practices? The case of conservation agriculture with trees in Kenya	*Agroforestry Systems*	Kenya	Participatory farmer training groups	Quantitative evaluation: IV	Uptake of conservation agriculture technology	No
68	Witt et al. (2008)	The farmer field school in Senegal. Does training intensity affect diffusion of information?	*Journal of International Agricultural and Extension Education*	Senegal	FFS	Quantitative evaluation: NCIA	Knowledge diffusion	No
69	Yamazaki & Resosudermo (2008)	Does sending farmers back to school have an impact? Revising the issue	*The Developing Economies*	Indonesia	FFS	Quantitative evaluation: DiD	knowledge acquisition; knowledge diffusion	Yes

PROOF ONLY

PROOF ONLY

70	Yang et al. (2008)	Effects of training on acquisition of pest management knowledge and skills by small vegetable farmers	*Crop Protection*	China	FFS	Quantitative evaluation: DiD	knowledge acquisition; skills	Yes
71	Yorobe et al. (2011)	Insecticide use impacts of integrated pest management (IPM) farmer field schools: evidence from onion farmers in the Philippines	*Agricultural Systems*	Philippines	FFS	Quantitative evaluation: IV	Insecticide use	No